Cognitive mechanisms matter - but they do not explain the absence of teaching in chimpanzees

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Abstract: Kline's functional categories for the evolution of teaching blur some valuable distinctions. Moreover, her account provides no answer to the

question of why direct active teaching seems to be a uniquely human phenomenon.

We admire Kline's attempt to illuminate the evolution of teaching via a taxonomy of different varieties, and by considering the adaptive pressures and costs that might lead to their emergence. At the same time, we doubt that Kline's theoretical distinctions are the best formulations.

Kline defines 'stimulus enhancement' as occurring when "the teacher stimulates the pupil's interest in a stimulus or location" (lines 609-610). In thereby characterising it as including cases in which a teacher *intentionally* draws attention to something, Kline departs from standard usage of this term (e.g., Whiten & Ham 1992) in comparative psychology, in which one agent's activities make salient to another some valuable information. Importantly, on this usage, enhancement can be provided even when an agent is oblivious to the presence of an onlooker – and so is cognitively undemanding. Since Kline includes as examples of stimulus enhancement cases of pointing that are typically thought cognitively difficult (Clark 1996; Tomasello 2008; Moore 2013b), her taxonomy glosses cognitive issues that have been considered foundational in the evolution of human cognition. While Kline motivates her functional approach by stating that behaviour (and not cognition) is the target of natural selection, a taxonomy that lumps together behaviours supported by different cognitive abilities and appearing in only distantly related clades is not intuitively a useful tool for understanding evolution. It may lead researchers both to over-estimate the relatedness of different behaviours on account of functional similarities, and to overlook the similarity of cognitively related behaviours performed with different functions.

It's also not clear to us that Kline's terminological distinctions are illuminating. For example, while she describes the flossing of teeth by long-tailed macaques (Masataka 2009) as a form of stimulus enhancement, the same behaviour is also consistent with her criteria for direct active teaching – since it could well be characterised as a "non-verbal demonstration, punctuated with exaggerated movements, by an expert ... to a novice" (*ibid*. lines 658-659).

Indeed, we often engage in direct teaching by drawing others' attention to important features of objects - suggesting that Kline's categories are also not mutually exclusive. It is also hard to see why the cases of informative pointing that Kline counts as stimulus enhancement are not cases of active (albeit pre-verbal) teaching; and why the Warao father's adjustment of his son's wrist is a case of direct active teaching, and not evaluative feedback.

The confusions caused by these overlapping categories are unlikely to facilitate identification of cases of teaching in the animal kingdom. Moreover, they undermine our confidence that this new theoretical framework could be used to generate new scenarios for testing for the presence of teaching. Consequently, while Kline's categories are thought-provoking, it's not clear that they improve on the categories of social learning already described by others (e.g., Whiten & Ham, 1992).

In fact, we doubt that Kline has over-estimated cases of active teaching - at least among chimpanzees. Since chimpanzees are among our nearest living relatives, their teaching activities are of great interest for understanding the evolution of our own. We agree with Kline that intentional and 'theory of mind' based teaching approaches sometimes overstate the social cognition that active teaching requires (Moore 2013a), and so agree that "the constraints of cognition ... do not seem sufficient to explain why direct active teaching appears to be limited to humans" (lines 1325-1326). But then why isn't more active teaching found in chimpanzees?

It seems unlikely that researchers have simply been looking in the wrong place, because several groups (Matsuzawa et al., 2001; Lonsdorf, 2006; Dean et al., 2012) have tried and failed to substantiate earlier reports (Boesch 1991). Kline's emphasis on adaptive value may hold out an answer here.

Boesch (1991; 2012), has argued that chimpanzee mothers at Taï teach their children how to crack panda nuts. Because the *Panda oleasa* is particularly hard and difficult to crack, juvenile chimpanzees don't typically succeed until they are eight years old. Since the chimpanzee interbirth interval is five years,

Boesch argues that the demands of having two dependent offspring may push mothers to accelerate their offspring's learning. We find this explanation unlikely. While the panda nut may be highly valued, it constitutes neither a large nor an ineliminable part of the Taï chimpanzee diet (Boesch & Boesch-Achermann 2000, p. 210, themselves describe Panda nut consumption as "rare" and "irregular"). Thus, there is likely to be little adaptive pressure for teaching this skill. Given the scant evidence of teaching in chimpanzees, and the failure of others to find further evidence supporting Boesch's reports, it seems advisable to doubt that it's really happening. Why would this be?

One answer favoured by Kline and others (e.g., Gergely & Csibra 2005) is that behaviours that are both complex and difficult to learn through observation should lead to pressures for the emergence of teaching. Since naive captive individuals have already proven able to reinvent various wild "cultures" without social learning (Huffman & Hirata 2004; Allritz, Tennie & Call 2013; Menzel et al. 2013), such opaque behaviours may not exist in chimpanzee culture. Therefore non-teaching learning mechanisms may suffice for the propagation of contemporary chimpanzee technologies – including different forms of observational learning, individual learning, and inherited cognitive skills (Tennie et al. 2009, 2012; Moore, 2013a). This may be true even for the most complex multi-tool sets (e.g., Sanz & Morgan, 2007; Boesch, Head & Robbins, 2009).

We suspect that chimpanzees have simply faced little adaptive pressure for tools and tool-sets more complex than those that they already possess. Since they were never forced to leave their ecological niches, simpler forms of learning and social learning always sufficed for them to acquire whatever tools, tool-sets and communicative devices they needed. This would explain the lack of pressure for active teaching, not to mention the comparative absence in chimpanzees of high-fidelity learning mechanisms like imitation. Given her closing comments about the adaptive value of teaching, we think Kline would agree with this conclusion. But it's not clear why we needed her theoretical framework to get there.

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